Title: Hold On To Your Pennies!

Link to Outcomes:

- **Problem Solving** Students will demonstrate their ability to solve open-ended problems using different strategies.
- **Communication** Students will communicate by reading passages related to pennies, discussing the results of the data, and writing their observations.
- **Reasoning** Based on experience and ideas, students will demonstrate their ability to reason by supporting their theory of why some students can hold more pennies than others.
- **Connections** Students will connect mathematics to language arts by reading and writing about pennies.
- **Estimation and Computation** Students will use estimation strategies and computational skills during the investigation.
- **Geometry and Spatial Sense** Students will plot points on a coordinate grid and will determine the areas of their hands.
- **Measurement** Students will demonstrate and apply concepts of measurement using metric and customary units. They will estimate and verify their measurements.
- **Statistics** Students will collect, organize, display, interpret, and analyze data. They will construct line plots, stem and leaf plots, scatter plots, and glyphs.
- **Patterns and Relationships** Students will describe the correlation between two sets of data by interpreting a scatter plot.
- **Mathematical Disposition** Students will be actively involved in hands-on activities that promote a positive experience in data analysis.

Brief Overview:

Students will explore various graphic-displaying techniques through hands-on activities by using pennies. They will collect, organize, display, interpret, and analyze a set of data. These activities will integrate geometry with the use of area and language arts through reading and writing activities.

Grade/Level:

Grades 4-6

Duration/Length:

Four one-hour class sessions

Prerequisite Knowledge:

- Students should be able to count in multiples.
- Students should have the knowledge of mean, median, mode, range, and outlier.
- Students should be able to determine the area of an irregular closed figure.
- Students should be able to use a metric ruler to measure units.

Objectives:

- Collect and display data using a line plot, stem leaf plot, scatter plot, and a glyph.
- Determine the appropriate uses of graphic displays.
- Interpret and analyze data through observations and reasoning.
- Communicate analysis of data through written and oral language.

Materials/Resources/Printed Materials:

Materials (per group of four)

- Sticky notes
- 200-300 pennies
- Cereal-sized bowl
- Pennies Student Resource #1 - Math Performance Task: Hold On To Your Pennies!
- Pennies Student Resource #2 - Hold On To Your Pennies!

Materials per student

- Cm^2 graph paper
- Metric ruler
- Pennies Student Resource #3 - Stem And Leaf
- Pennies Student Resource #4 - How Many Pennies?
- Pennies Student Resource #5 - Check Your Area
- Pennies Student Resource #6 - Is There A Difference?
- Pennies Student Resource #7 - Is There A Mean?
- Pennies Student Resource #8 - Hold On To Your Pennies

Teacher Materials

- Overhead copy of cm^2 paper
- Pennies Teacher Resource #1
- Chart paper to display class results

Reading Resources

Exploring Data: Teacher's Edition, Landwehr, James M., and Ann E. Watkins, California: Dale Seymour Publication, 1996.

Children's Literature Connections

Alexander Who Used To Be Rich Last Sunday by Judith Viorst

Henry's Pennies by L. McNamara

Hundred Penny Box by C. Mathias

Million Dollar Jeans by Ron Roy

Additional Resources

"Penny Patterns" by Dave Young. November issue, AIMS Educational Foundation (Magazine).

Development/Procedures:

Day 1 - Activity 1

- Students will estimate how many pennies each can hold in one hand and construct a line plot with the data collected. Cooperative group roles will be assigned.
- Teacher will introduce and create an interest into the investigation by reading Alexander Who Used To Be Rich Last Sunday by Judith Viorst.
- Teacher will divide students into groups of four and will assign each student one of the following roles: materials gopher, recorder, reporter, and timekeeper.
- Each student will examine a penny and write an estimate on a sticky note for how many pennies each student can hold in one hand.
- Teacher will then direct the students to place their sticky notes on the chalkboard and lead a discussion on how the class can organize this data.
- Teacher will introduce a line plot as a way to organize and display this data. Teacher will draw a line plot on a chalkboard according to the range of data, starting with the lowest estimate. Each student will place a sticky note on the line plot in the appropriate place.
- Under Activity #2 of Student Resource #1, students will write three observations about the class estimates by observing the line plot they created.
- Pass out one "Hold On To Your Pennies" (Pennies Student Resource #1) to each group. The recorder will list all members' names and their estimates.

Activity 2

- Students will individually collect and record the data on the Student Resource #2.

- Each student will collect data by reaching into a bowl full of pennies and grabbing one competitive handful. Each group member will count the number of pennies and record the results on the "Hold On To Your Pennies."

- Teacher will collect Pennies Student Resources #1 and #2 to be used the next day.

Day 2

- Pass out Pennies Student Resources #1 and #2 so that students and teacher can compare and analyze the results of the data collected from the previous investigation. They will construct a stem and leaf plot using the information gathered from the data collected by grabbing handfuls of pennies.

- Using the data from the worksheet, the teacher will elicit the range of the data from the students and begin to draw a number line for the construction of a line plot on the chalkboard. (The number line will probably have a large range of values which will take up too much space.) The teacher will lead a discussion as to why a line plot may not be the best choice to display this data.

- Introduce and construct a stem and leaf plot as an alternative way to graphically display the data using "Stem and Leaf" (Pennies Student Resource #3).

- After the stem and leaf display has been completed on Pennies Student Resource #3, the teacher will review on the following vocabulary words:

  mean mode outlier
  median range

  Students will then complete Student Resources #1, #2, and #3 and discuss the findings.

Day 3

- Students will find the correlation between the area of the hand and the amount of pennies it can hold by constructing a scatter plot.

<u>Activity 1</u>

- Teacher will pass out Pennies Student Resource Sheet #4 and will read the poem *"How Many Pennies?"* to stimulate the correlation between the area of the hand and the amount of pennies held.

- Students will write a response to the poem and create an original poem about pennies on the resource sheet.

Activity 2

- Students will trace their closed flat hands on centimeter^2 paper and find the areas of their hands by counting the number of squares. Instruct the students to use parts of squares to make whole squares. Ask them to record the area on the drawn hand.

- Teacher will ask six to ten students what the areas of their hands are and the number of pennies each could hold in one competitive handful. Teacher and students will use these results to construct a chart (see example below). Pass out Student Resource #5. Teacher and class will observe the data to see if there is a correlation.

name	area of hand	# pennies

- Teacher will introduce and construct a scatter plot using the information from the chart. Teacher will discuss with the students different ways to observe and analyze this type of data. Students will be guided toward the use of a scatter plot as a better representation of two variables.

- Teacher will collect information from the rest of the class and add it to the chart. Students will use data and "Is There A Difference?" (Pennies Student Resource #6) to create their own scatter plot and write an analysis of the data.

Day 4

- Students will create a glyph to show the correlation between the size of boys' or girls' hands and the amount of pennies they can hold.

- Students will write a prediction in their journals to the question, "Can boys or girls hold more pennies in their hands?" Teacher will hold a class discussion about the responses.

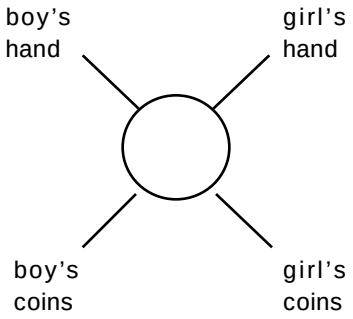
- Teacher will introduce a circle-ray glyph (a pictorial representation of data) as a good visual representation of this data. Teacher will gather data and place it on a chart (see example below). Ask students to copy chart.

	Area of Hand	Actual Amount of Pennies
boys		
girls		

- Teacher should draw a circle on a separate sheet of chart paper.

- Teacher will ask students to find the mean for the hand size of each gender and the actual amount of coins held and record the results on "Is There A Mean?" (Pennies Student Resource #7).

- Teacher will model for students how to use the key for the circle-ray glyph to construct the lines (rays) on the circle (see example below).



- Students will complete their glyphs, and write a paragraph about the information they gathered for the glyph on Pennies Student Resource #6 using the mean for each piece of data.

- Together students will create a summary on chart paper to display in the class.

Evaluation:

Students will be evaluated by their ability to:

- work cooperatively with group members.
- determine the area of their hands.
- construct a line plot, stem and leaf plot, scatter plot, and a glyph.
- write observations and analyze data.

Extension/Follow Up:

Give each student a penny. As a writing extension, students may write a story titled "The Life Of My Penny." The story should begin at the U.S. Mint. They may tell where the penny traveled, what adventures it had, who it met along the way, and its final resting place. Pass out Pennies Student Resource #8, Writing Prompt.

Teacher may use rubric (Pennies Teacher Resource #1) for grading purpose with writing prompt.

Begin a penny saving campaign and donate money.

Students could also write a paragraph about what they would do with the number of coins they held in their hands.

Possible math extensions could be to substitute another coin in place of the penny. A probability activity could be to put different coins in a bag and decide the probability of choosing certain coins.

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Group _____ Date _____

Math Performance Task: Hold On To Your Pennies!

Objective:

You will use estimation strategies and computational skills during a hands-on activity using pennies. You will collect, organize, display, interpret, and analyze data and construct a line plot.

Materials Needed:

- Pennies Student Resource Worksheet #2
- 200 - 300 pennies per group
- a container to hold the pennies
- a package of sticky notes

Activity #1:

Working in cooperative groups, you will examine a penny and estimate how many you can hold in one hand. Write your estimate on a sticky note.

Activity #2:

Discuss the range of numbers on the sticky notes and how to set up a line plot. Construct a class line plot on the chalkboard using the data on the sticky notes. Write three observations about the information gathered from the line plot which the class created.

_____

_____

_____

_____

_____

_____

_____

Activity #3:

The recorder will record on Student Resource Worksheet #2 each group member's name and estimation of how many pennies he can hold.

*Each student will collect data by reaching into a bowl full of pennies and grabbing one competitive handful. Each group member will count the number of pennies and record the results on the "Hold On To Your Pennies" (Student Resource #2).

*Compare the actual results with the estimated amount of pennies you thought you could hold. Record how close your estimate was.

*Write what you learned from performing this task.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Group_____ Pennies Student Resource #2

Hold On To Your Pennies

Use the chart to record the group's data.

Name	Estimate of Pennies Held	Actual Pennies Held	How Close Was Your Estimate?



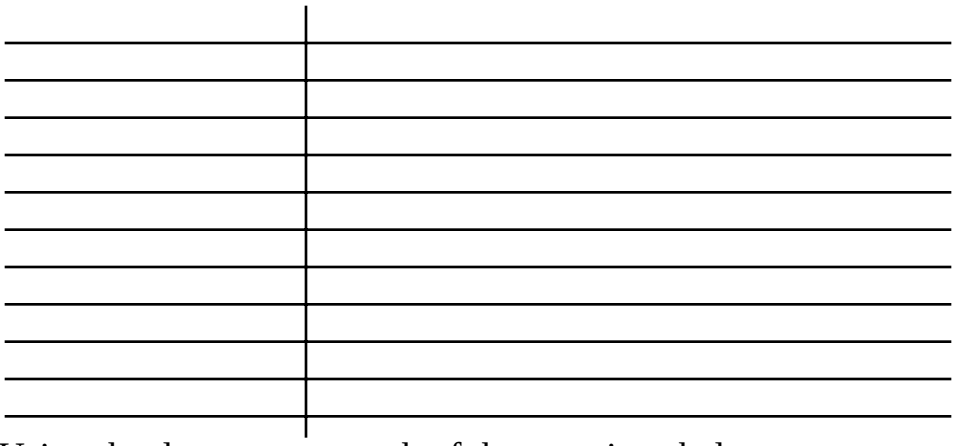
Name_____ Pennies Student Resource #3

Stem and Leaf

Activity 1: In the space below, collect the class data on the actual amount of pennies each student held. (Record data here.)

Activity 2: Use the data to construct a stem and leaf plot with your teacher.

_____
Title



Activity 3: Using the data, answer each of the questions below.

1. What is the mode of this set of data? _____
2. What is the median of this set of data? _____
3. What is the mean of this set of data? _____
4. What is the range of this set of data? _____
5. Is there an outlier? If so, what is it? _____
6. Is one of these statistical pieces of information a better summary for this set of data? Use the information to explain your answer.

7. What conclusions can you draw from the shape of the data?

Name_____ Pennies Student Resource #4

How Many Pennies?

How many pennies can you hold?
Does it matter if you're young or old?
If you're big, can you hold a lot?
Maybe so, maybe not.
When I was small, I only held a few
Now that I'm larger, can I hold more than you?

Dionna D. Ricks

Activity 1: Read the poem. How does this poem relate to our class investigation of pennies?

_____

_____

_____

_____

Activity 2: Create an original poem about pennies.

_____

_____

_____

_____

Name_____ Pennies Student Resource #5

Check Your Area

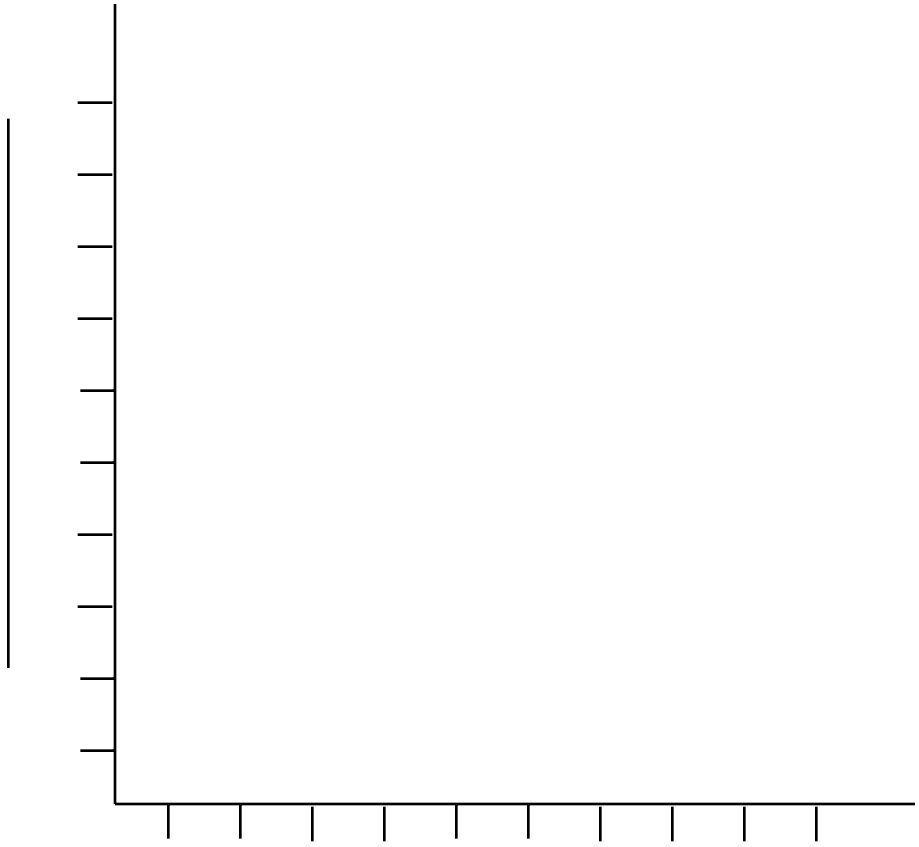
Name	Area of Hand	Number of Pennies
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		
21.		
22.		
23.		
24.		
25.		
26.		
27.		
28.		
29.		
30.		

Name_____ Pennies Student Resource #6

Is There A Difference?

Using the class data, create a scatter plot to show the difference between the size of a hand and the amount of pennies it can hold.

_____
Title



_____

Write two conclusions based on your observation of the scatter plot.

1. _____

_____

2. _____

_____

Name_____ Pennies Student Resource #7

Is There A Mean?

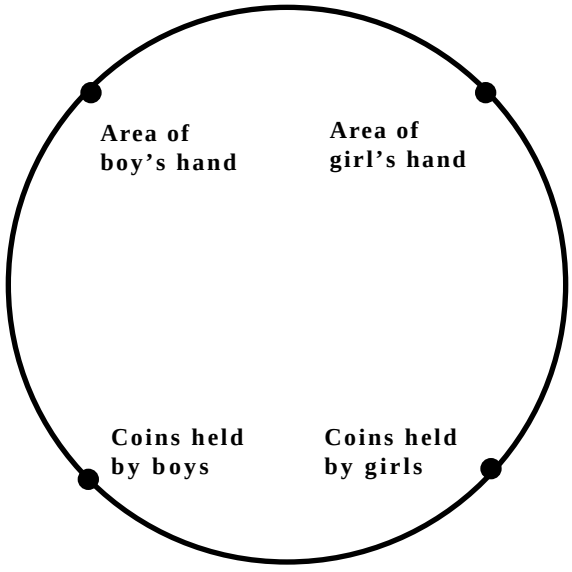
Using the data gathered on the class chart, find the mean for each category.

1. mean area of boy's hand _____cm^2
2. mean area of girl's hand _____cm^2
3. mean number of coins held by a boy _____
4. mean number of coins held by a girl _____

Whose Hand Holds More?
(Circle-Ray Glyph)

1. Using the glyph key, measure and draw a line on the circle to represent the mean for the **handsize** of each gender.
2. Use the same procedure to represent the mean of **coins held** by both genders.

_____
Title



KEY

1CM = 20 SQ. CM
1CM = 25 COINS

3. Write a paragraph about the information you gathered from the glyph.

HOLD ON TO YOUR PENNIES
WRITING PROMPT

You have now managed to acquire a lot of knowledge about pennies and how to work with the data you have collected. As an extension to our penny unit, I would like for you to create a story titled "The Life Of My Penny."

First, think about where your penny might have been and where it has traveled. Can you imagine all the different people your penny has met? Now think about what adventures your penny has had along the way and who your penny has met. Finally, think about the final resting place of your penny. Where did it finally end up?

Follow the writing process as you create your story. First web your ideas for each of these different segments:

- Where has it traveled?
- Who did it meet?
- What are some advantages it had?
- What is the final resting place?

Next, using your web, write a rough draft of your story. Get your ideas down. Now go back and revise and edit your rough draft. Make sure you use specific ideas and explain and expand your sentences. Let your story say what you want it to say. Look for spelling, capitalization, punctuation, and grammatical mistakes. Finally, after making all the corrections, publish your story by writing a final copy in your best handwriting or typing in a final copy on a computer. Then make a cover for your story. You may add graphics to your story and cover if you desire.

I can't wait to see your penny come alive. Happy writing!!

HOLD ON TO YOUR PENNIES
Writing Prompt Rubrics

- Includes a title

_____	_____	_____	_____	_____
1	2	3	4	5

- Tells where penny has traveled

_____	_____	_____	_____	_____
1	2	3	4	5

- Tells who penny met

_____	_____	_____	_____	_____
1	2	3	4	5

- Tells adventure of penny

_____	_____	_____	_____	_____
1	2	3	4	5

- Tells pennies final resting place

_____	_____	_____	_____	_____
1	2	3	4	5

- Expresses ideas clearly — uses specific details and expanded sentences

_____	_____	_____	_____	_____
1	2	3	4	5

- Edited the story for spelling, capitalization, punctuation, and grammar

_____	_____	_____	_____	_____
1	2	3	4	5

- Story followed the writing process

_____	_____	_____	_____	_____
1	2	3	4	5